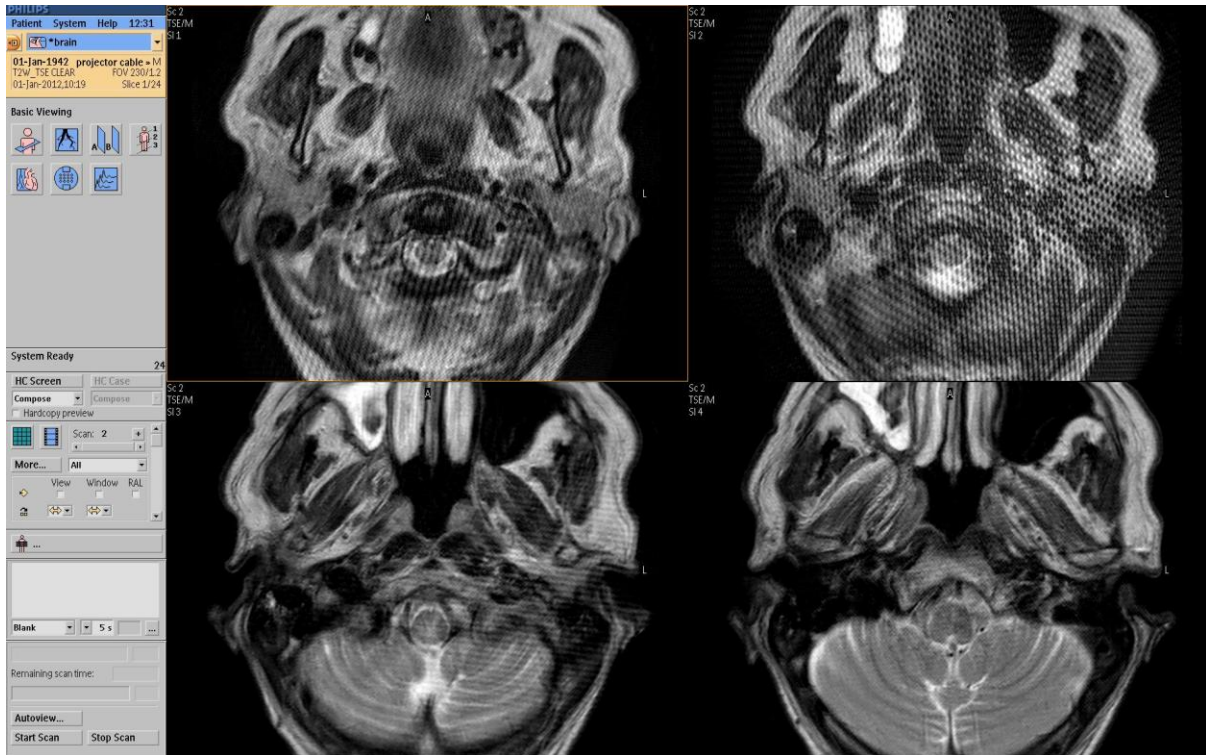


Spikes

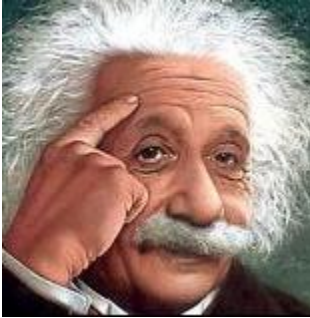
The Who,s Why Where When and What



2013 by Ton van der Steen

Content

1. What is a Spike?
2. How to recognize spikes and how it affects the image Quality?
3. Which Spike behavior we know?
4. What can cause spikes?
5. How to fault find spikes?
6. What to do if spike issue is solved?



Procedures :

- How to perform QBC Sweep
- How to use RADAR to diagnose remotely spikes
- Spike fault finding on a Ingenia system
- Make Raw Data visible <rel 4
- Make Raw data visible R 4

1. What is a Spike?

The name Spike comes from the appearance of white dots in the viewable raw data.

The definition of a spike is a sudden, sharp increase in the received signal. NOT caused by the MR response of the object. Magnetic Resonance systems are sensitive for RF disturbances caused by electrical and electrostatic discharges (ESD) inside the examination room.

Some examples of an Electrical discharge:

- Interrupt current –like a bad contact (cables, connectors, switches)
- Spark caused by high voltage
- Partial discharges

Electrostatic discharges are a well-know phenomenon. It affects many industries in diverse environments.

Static charge buildup can be caused by friction between two surfaces. This is called tribo-electrification; Electrons migrate from the surface of one material to the surface of the other.

Upon separation of the two surfaces, one surface loses electrons and become positively charged. The other surface gains electrons and becomes negatively charged.

In MR we distinguish 3 categories of spike levels

- **Spike level <6 times the background noise.** The QPI value of these spikes is not calculated.
- **Spike level between 6 and 70 times the level of the background noise.** This type of spikes will influence the signal to noise performance of the system The QPI value of these spikes is displayed as SPK: noise QPI
- **Spike level > 70 times the value of the background noise.** The QPI value of these spikes is displayed as SPK: Visibility QPI

Note:

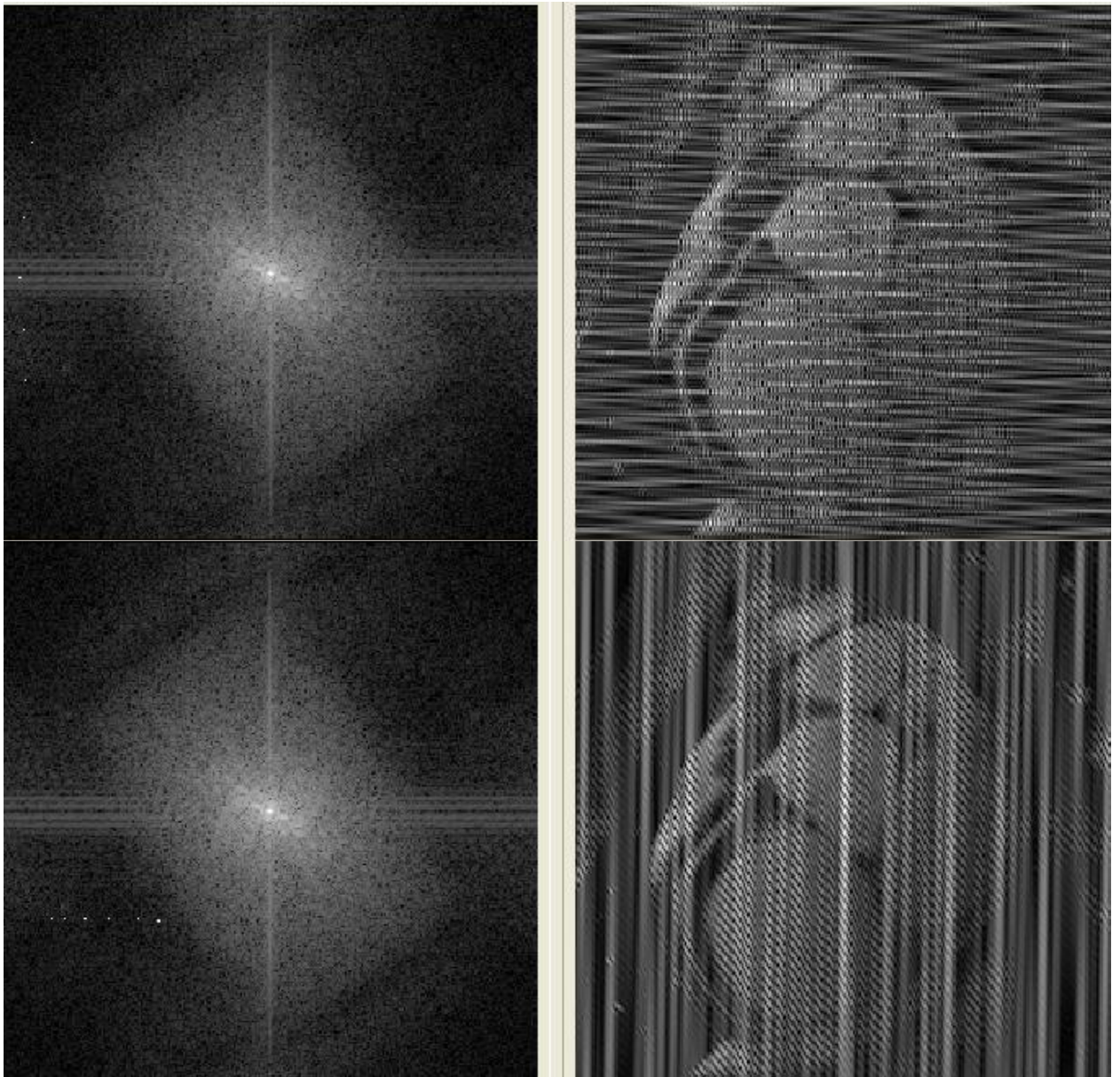
Spikes can cause increase of noise level of image

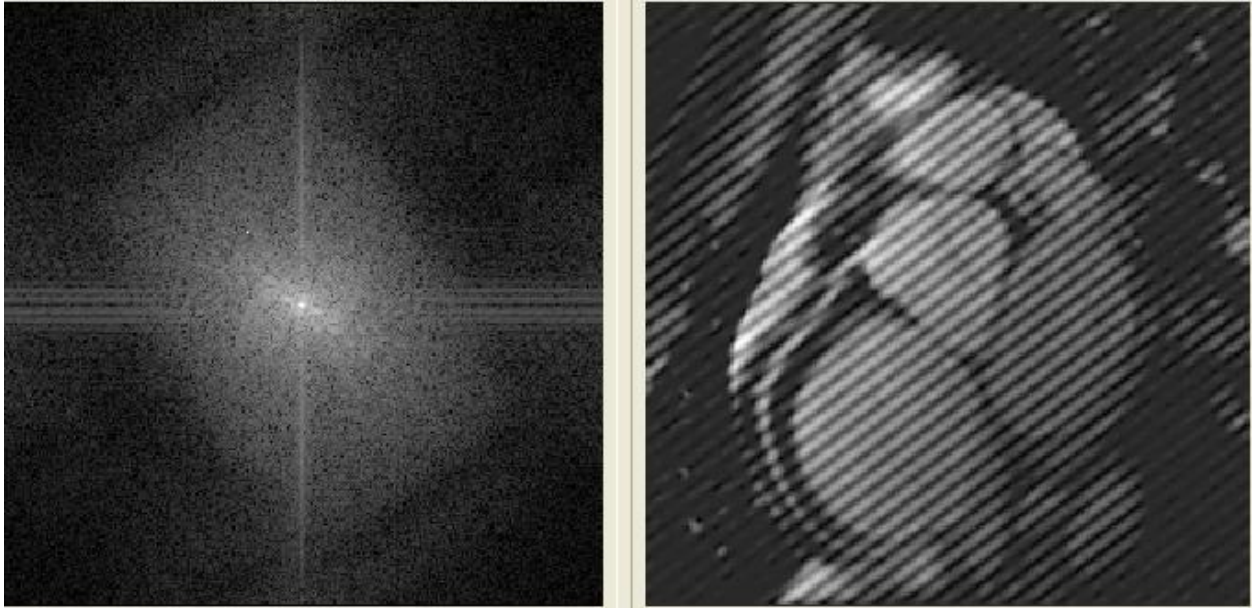
Spikes can cause wavy pattern in image

2. How to recognize spikes and how it affects the image quality?

When a system contains spikes the customer starts to complain about Image Quality issues

The following Image Quality issues are known due to spikes;





“Spikes” are visible as white dots in the raw data. Note; also sometimes a line (line is a collection of dots) is seen in the raw data many dots in one profile.

Depending of the position of spikes in the raw data, horizontal or vertical or oblique lines are visible in the clinical image.



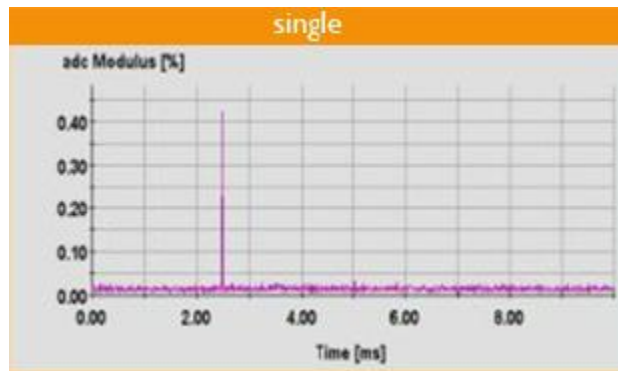
Be aware spurious interferences can also cause line artifacts in the clinical image

3. Which Spike behaviour do we know ?

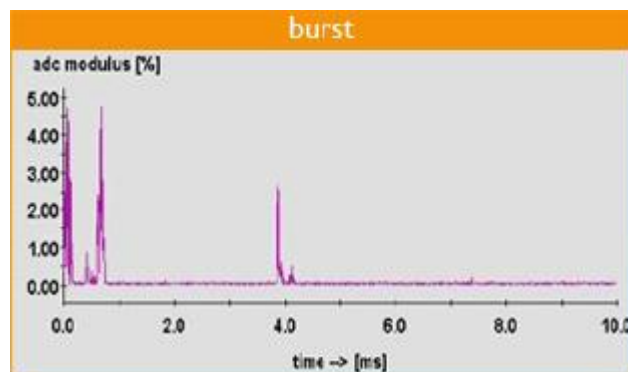
Theoretical we can separate spikes into 4 different behaviors, single, Burst, Resonance, and Erratic.

Note: In practice it can be possible that we may have a combination from all 4 !

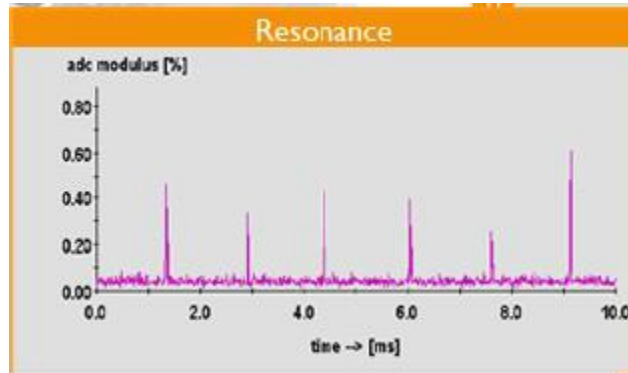
- **Single Spike** Type 1 (Can be caused by Small loose parts)



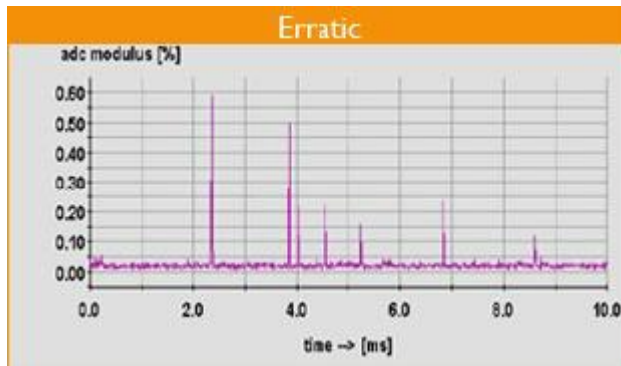
- **Burst Spikes** Type 2 (Always caused by Gradient related , coil, bars connectors, cables)



- **Resonance** Type 3 (Always caused by Airflow sensor, Helium pressure switch, or a device that is switching like charge unit emergencies lights)

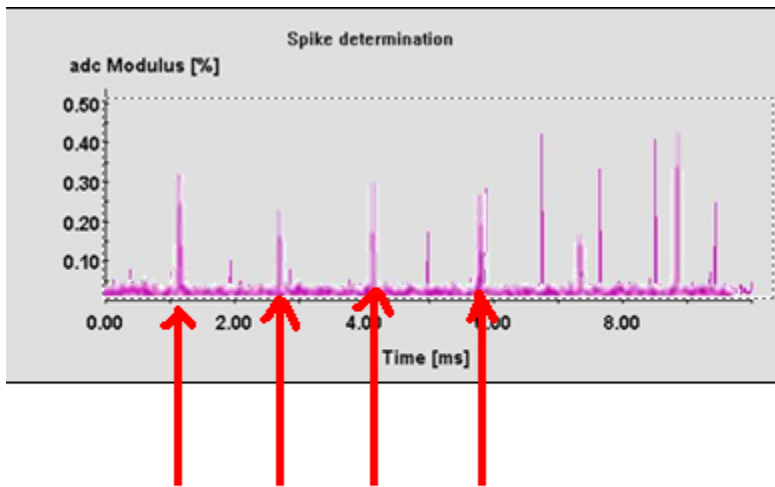


- **Erratic** Type 4 (loose / vibrating parts / friction between cable isolation metal part)



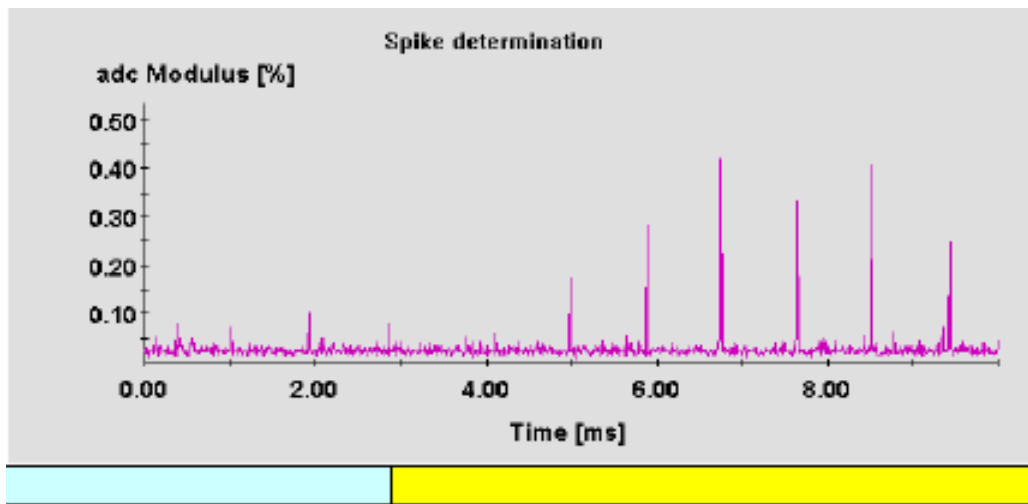


Combination of Spikes



Resonance Spikes

Spikes after the gradient pulse



Gradient pulse

After Gradient pulse

When the **highest** spikes are **after the gradient** pulse's the distance to the spike source is further away from the gradient coil (e.g. room lights, loose part close to RF cage)

4. What can cause Spikes?

Single Spike Type 1 / Burst Spike Type 2/ resonance Spike Type 3/ Erratic spike Type 4

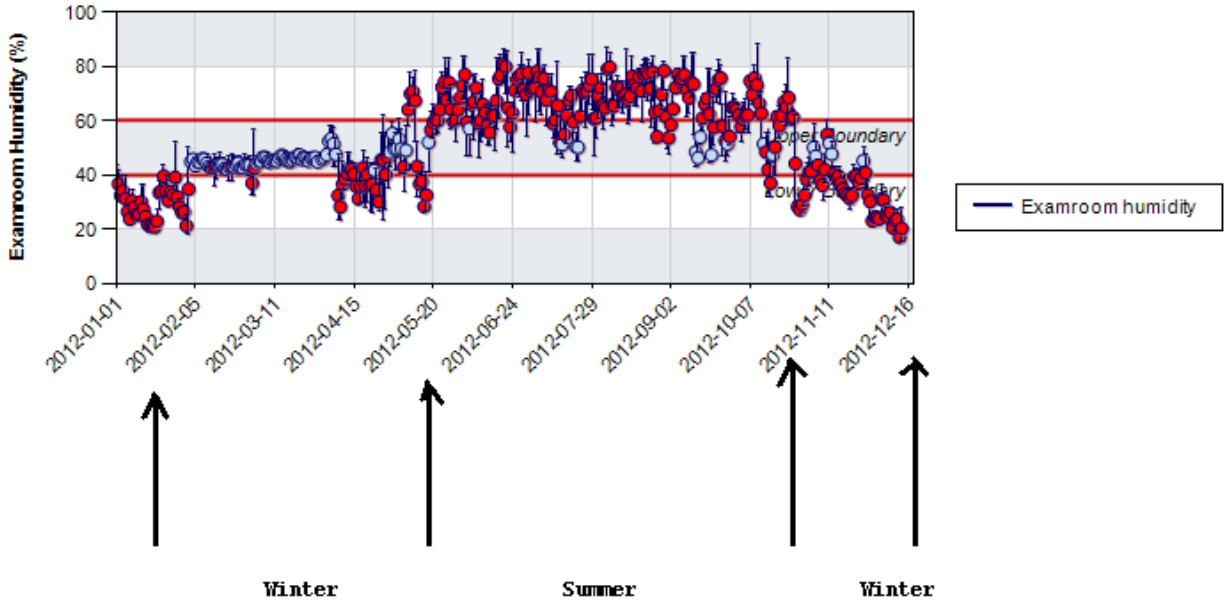
- | | |
|--|--------------|
| ○ Loose parts (anywhere inside the room) | Type 1/4 |
| ○ Loose connectors | Type 4 |
| ○ Vibrating gradient cables | Type 2 |
| ○ Friction | Type 1/4 |
| ○ Helium line toughing magnet or false ceiling | Type 1/4 |
| ○ Airflow or helium pressure switch | Type 3 |
| ○ Emergency light (charging part) | Type 3 |
| ○ Empty shim rails | Type 1/4 |
| ○ Clicksons in gradient coil | Type 4 |
| ○ Finger protection switch | Type 4 |
| ○ Fan in patient support | Type 4 |
| ○ Not grounded grid of the false ceiling | Type 4 |
| ○ Environment airflow/humidity | Type 1/2/3/4 |

In above column is clearly seen that due to the environment all different kind of spikes can/will occur.

Because of this phenomenon it has **NO** use to fault find spikes when the Environment is far out of specifications

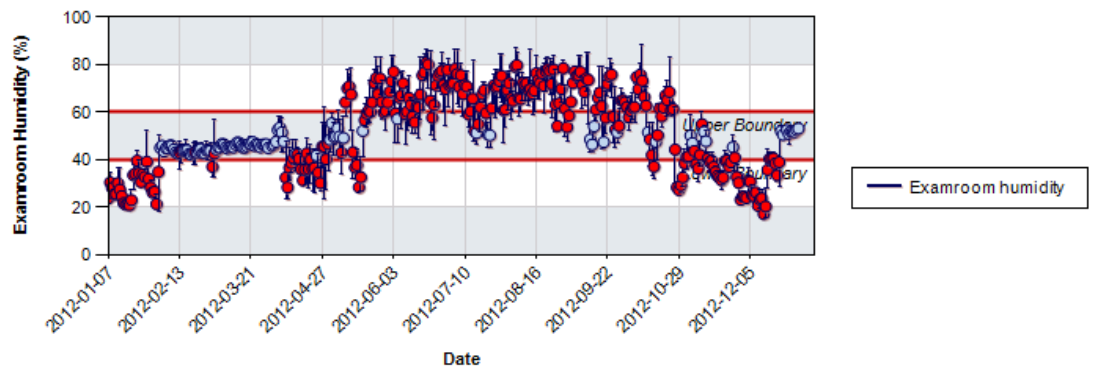
Below example graph shows a clear image of how the environment acts versus seasons if the AC system not 100% functional.

Example of low humidity spikes appearance in relation with the seasons



In above graph you clearly can see season influence In may I started to complain about the part usage on this site .They did the maintenance at the AC system . In Dec I complained again and resulted in humidity in specification again (maintenance done at AC system)

Examroom humidity (%)



5. How to prepare fault find Spike source(s)

Before start with finding the spike source(s) it is very important to know if the coil you use for faultfinding is **NOT** the source itself. A good practical example is.

Make a sweep (procedure 1)while using the QBC,QHC and a other coil available at the system.

If all 3 coils shows spikes the source is not coil dependable.

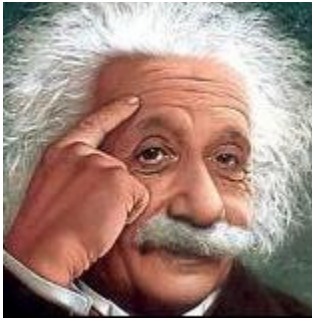
Another way to diagnose spikes via RADAR (see procedure 2) can be very useful it is also possible to diagnose which coil is generating spikes.

6. What to do if Spike issue is solved?

In many cases ,when the customer starts to complain about IQ issues the local engineer is redoing system level the results for the customer are the same (remember Spikes) After these actions most of the time application is involved also they start to solve the IQ issues by changing the exam cards/protocols.

Above actions did not solve the IQ issue because Spikes was the real root cause.

Always after the system is spike free repeat system level adjustments and ask application (in case they did) to re tune the exam cards/protocols.



Procedures

- 1) How to perform QBC Sweep
- 2) How to use RADAR to diagnose remotely spikes
- 3) Spike fault finding on a Ingenia system
- 4) Make raw data visible < Rel 4
- 5) Make raw data visible > Rel 4

Procedure 1

How to perform QBC Sweep

In the Field Service framework a number of spike tests and the spike localization tool are available. Location: *System Adjustments, Test and Tuning procedures, Diagnostic procedures, Spike test Body coil sweep.*

The screenshot shows a web browser window titled "Philips System Service Mode - Microsoft Internet Explorer". The page has a yellow background and contains the following elements:

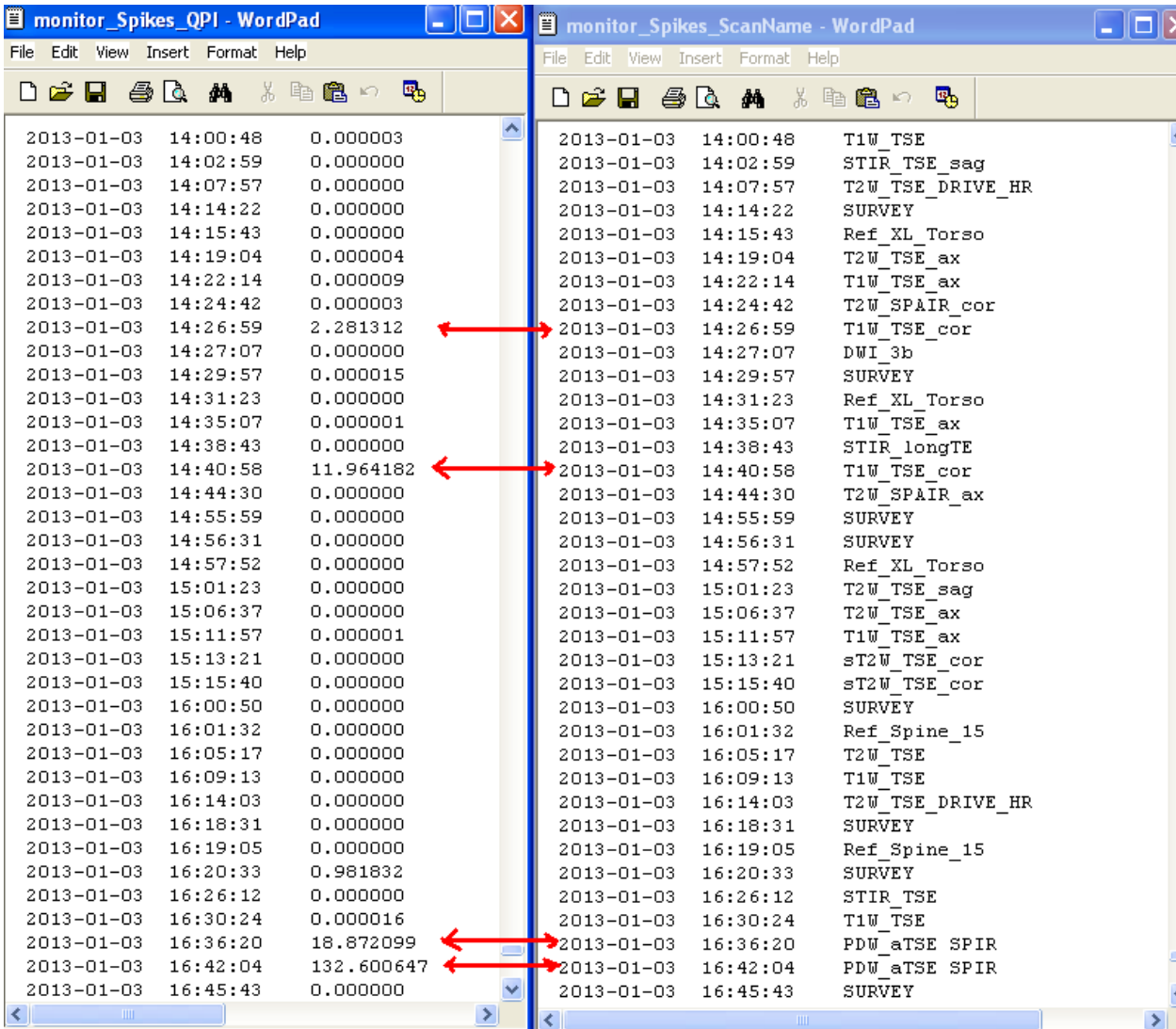
- System Status:** MR27
- Buttons:** "Up" and "Help Off".
- Service Mode:** Active
- Diagnostic procedures:** A list of folders and links under "Spike determination":
 - CDAS and PFEI
 - dStream
 - Reconstructor
 - Host
 - Magnet
 - High Order Shim (HOS) Power Supply (PS)
 - Gradient
 - Liquid Cooling Cabinet (LCC)
 - RF
 - Patient support
 - Patient communication
 - Physiology
 - Spike determination
 - Spike test TRH (no grad)
 - Spike test Posterior coil (no grad)
 - Spike test NVC (no grad)
 - Spike test Body coil (fast)
 - Spike test Body coil (std.)
 - Spike test Body coil (sweep)
 - Spike test TRH (fast)
 - Spike test TRH (standard)
 - Spike test TRH (sweep)
 - Spike test Posterior coil (fast)
 - Spike test Posterior coil (standard)
 - Spike test Posterior coil (sweep)
 - Spike test NVC (fast)
 - Spike test NVC (standard)
 - Spike test NVC (sweep)
 - Spike Localization (f)**
- Help -> Test and Tuning procedures...:**
 - The service procedures available for service usage are on the basis of:
 - The System Configuration.
 - The Service Authorization Level depending upon the authorization provided by the **Smartcard/Dongle** used.
 - The connection type: a local or remote session (a limited set of service procedures are available for a remote session).
 - If certain items are not available in the menu, please verify the System Configuration and Authorization Levels.
 - Command links in **bold and italic** starts the STT application to perform the service procedure.
 - Note I:** While tests are in progress, the Service Application (FSF) window may not be closed from Internet Explorer Close button.
 - Note II:** For some service procedures **monitoring display** is required. In case the monitoring display window is hidden by other windows, bring it to the front by clicking it on the task bar.

Procedure 2

How to check spike remotely via RADAR

- Login in to RADAR
- Click on downloads
- Click on Data file information
- Click on Filename Filter
- Click on monitor (be sure the selected period is > 2 month)
- Open Monitor.zip
- Open monitor_Spikes_QPI.dat
- Scroll to the latest date/time (leave this window open)
- Open Monitor_Spikes_ScanName.dat
- Scroll to the latest date/time

Now you are able to compare the QPI's and the scan name also here you are able to see if the spikes are related to a certain technique



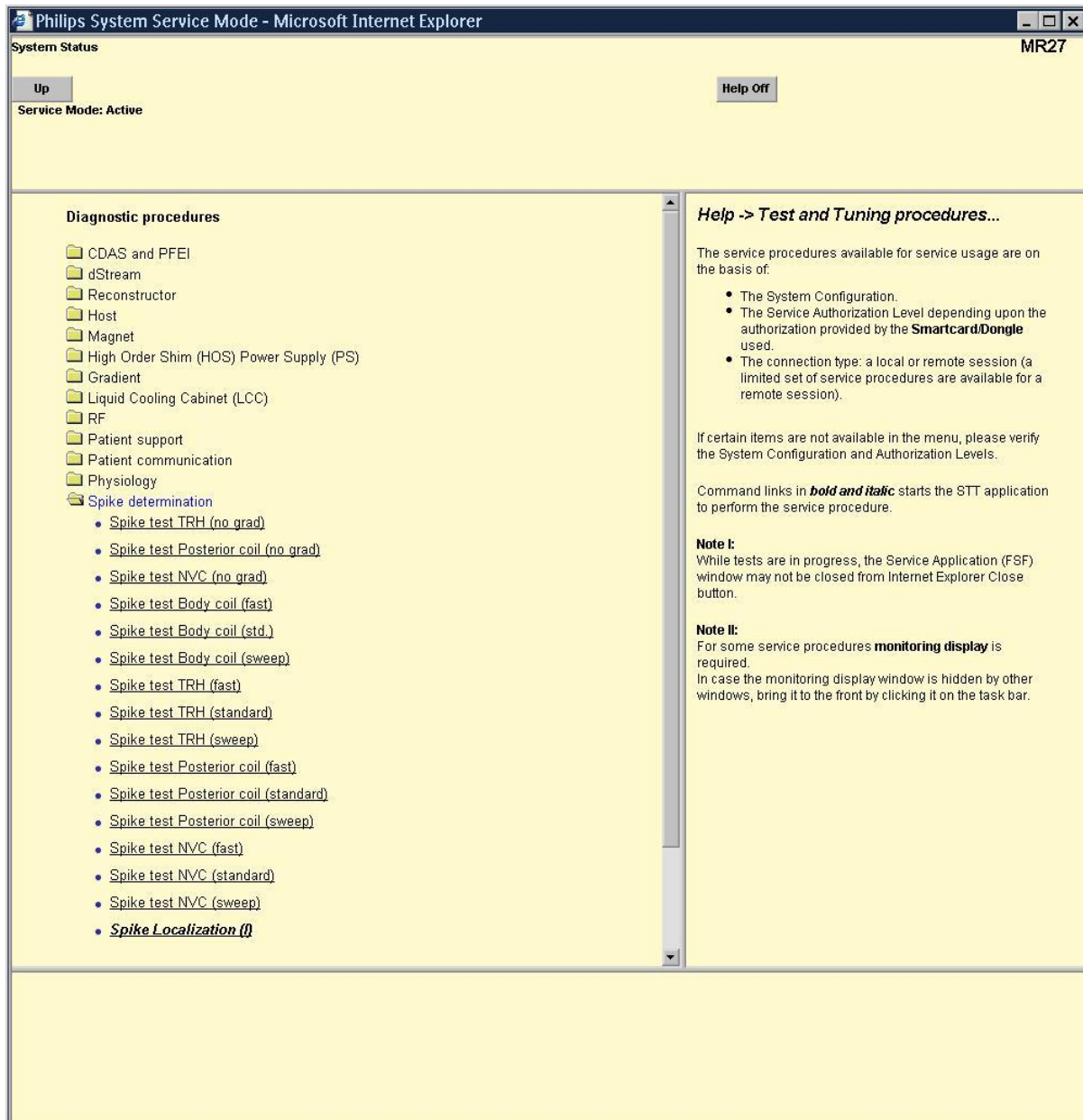
In this example is seen that the spikes pup op with a T1W_TSE_cor and pdw_aTSE spir
 Now you can go to the log files and check which coils are used.

Procedure 3

Spike searching on Ingenia systems

In the Field Service framework a number of spike tests and the spike localization tool are available.

Location: *System Adjustments, Test and Tuning procedures, Diagnostic procedures, Spike determination*



Location of the Spike tests and the spike localization tool in FSF

Several spike determination tools can be found here, using a variety of coils as receive coil in combination with different gradient sequences (fast, standard, or sweep)

What about Spike levels?

After the completion of every spike test an MRL is displayed:

Flag	Parameter Name	Actual Value	Nominal Value	Spec Value
	SPK: Noise QPI	0.23		
!	SPK: Visibility QPI	4.37		<1.0

We distinguish 3 categories of spike levels:

- Spike level < 6 times the background noise level.
The QPI value of these spikes is not calculated.
- Spike level between 6 and 70 times the level of the background noise.
This type of spikes will influence the signal to noise performance of the system.
The QPI value of these spikes is displayed as **SPK: Noise QPI**

At the bottom of the MRL a warning is displayed:

Found spikes can cause increase of noise level of image

- Spike level > 70 times the value of the background noise.
This type of spikes will have a strong effect on the signal to noise performance of the system or even cause image artifacts like grid patterns.
The QPI value of these spikes is displayed as **SPK: Visibility QPI**

Found spikes can cause wavy pattern in image

In the spike localization tool the Spike detection level is by default set to 70 times the value of the background noise. This means that only spikes are counted that will seriously affect the image quality.

gradient modes, and frequency ranges

The spike tests in FSF are available with 4 different gradient modes:

- No gradient
- Fast FFE like gradients on all channels (X,Y and Z)
- Standard FFE like gradients on all channels (X,Y and Z)
- Sweep EPI like gradients on the X and Y channel, frequency range 300 – 1300 Hz

During the **sweep** tests the gradients are pulsed within a certain frequency range. (the frequency is running from a high to a low value)

The idea behind this is that mechanical parts on the magnet or in the magnet room that are loose normally start vibrating when the gradient pulses match the resonance frequency of the loose parts. So at a certain gradient frequency the spike level will be maximal.

At the end of a spike test an MRL is created, with the measured spike levels for 4 different frequency areas (new feature for Ingenia systems)

Frequency range	Gradient strength
1300-950Hz	13.50 mT/m
949-626Hz	18.00 mT/m
625-525Hz	16.20 mT/m
524-300Hz	18.00



Do not exceed this maximum strength during spike localization because it will give confusing results! **If for example a gradient strength of 18 mT/m is used in the frequency range 1300-950 Hz spikes will always be detected.**

Therefore use the available parameter sets that are available in the Spike Localization tool.

Workflow

If spikes are detected on an Ingenia system a number of ‘known’ problem areas should be excluded first. See Ingenia FAQ document in Knova.

For a spike search action the following workflow is recommended:

1. Run one or more spike tests, e.g. spike test body coil (sweep) and spike test NVC (sweep) see paragraph 2.
2. Check the results of these tests. An MRL is created summarizing the noise and visibility QPI values for 4 frequency areas. The result of these tests can be used as input for step 3
3. Run the spike localization and focus on the frequency area with the highest qpi values. Try to localize the spike source with a coil that is suitable for ‘sniffing’ and solve the issues

The Spike test batches in FSF are pre-programmed sequences that cannot be modified. Apart from connecting the selected RF coil they do not require any user interaction.

Apart from the RF coil the bore should be empty. Do not connect the dStream interface, and do not position a phantom in the bore.

None of the spike batches use RF power; only the gradients are pulsed.

It is recommended to start with the **Spike test Body coil (sweep)** and the **Spike test NVC (sweep)**

Running a test takes ca 4 minutes. When finished an MRL is created, indicating Passed or warning for 4 frequency areas (new feature for Ingenia systems)

Example of MRL of spike test Body coil (sweep)

Test Name	Result
Spike test QBC (sweep) 1300-950Hz	Warning
Spike test QBC (sweep) 949-626Hz	Warning
Spike test QBC (sweep) 625-525Hz	Warning
Spike test QBC (sweep) 524-300Hz	Passed

Additionally a summary is created for each of these frequency areas. See appendix A for an example . In this example the highest spikes levels were detected in the frequency range 625 – 525 Hz. This is important input information for the spike localization tool. (par. 3)

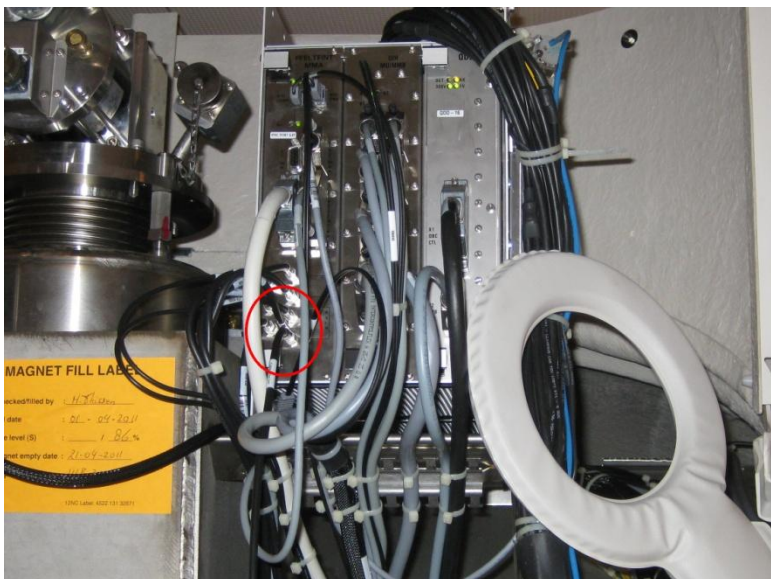
Spike localization with the delivered C1 coil

With the Ingenia systems a C1 coil is delivered as a service tool:



The C1 coil delivered with Ingenia systems

The big advantage of this coil is the fact that it has a long cable, allowing to move it all around the magnet. A big disadvantage is the fact that this coil is rather unsensitive, so only high spikes will be detected. The coil has to be connected to the **TFINT board, connector X10**.

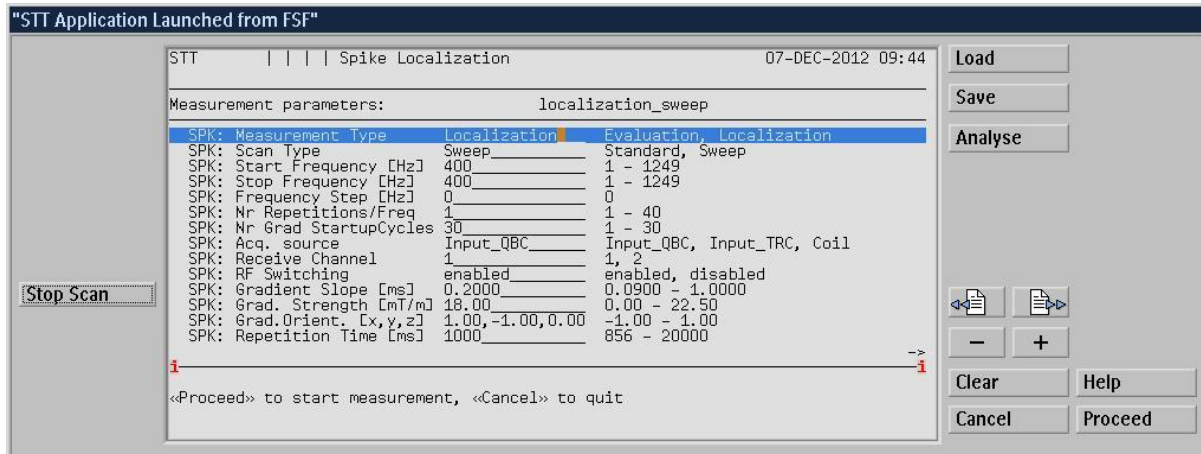


The C1 coil connected to the TFINT board of an Ingenia system

The spike localization tool can be found in FSF under ***Diagnostic Procedures, Spike Localization***.

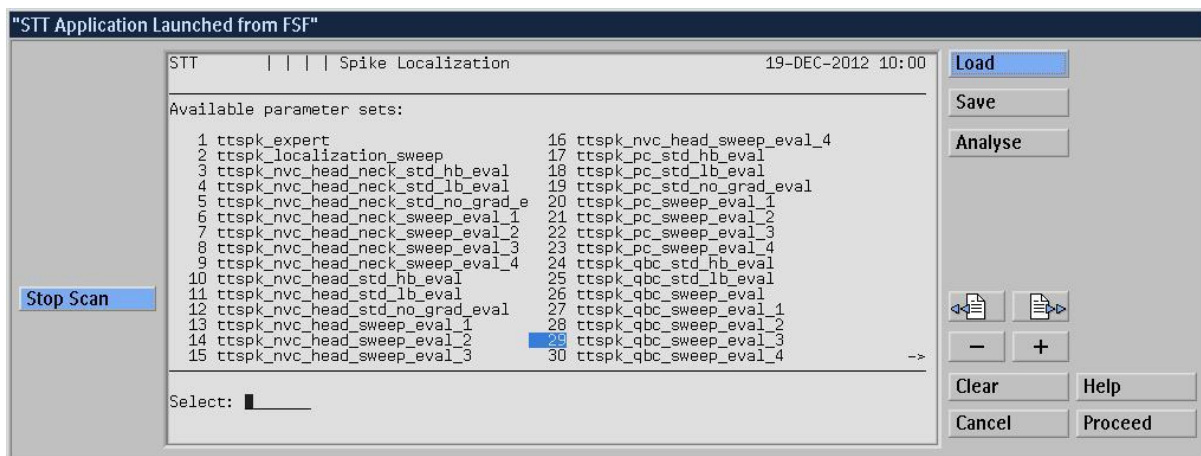
Depending on the results of the spike tests the spike localization tool can be used to locate the source of a spike. In this example the QBC sweep showed noise and visibility QPI values in the frequency range 625-525 Hz.

After starting the Spike Localization tool the following screen comes up:



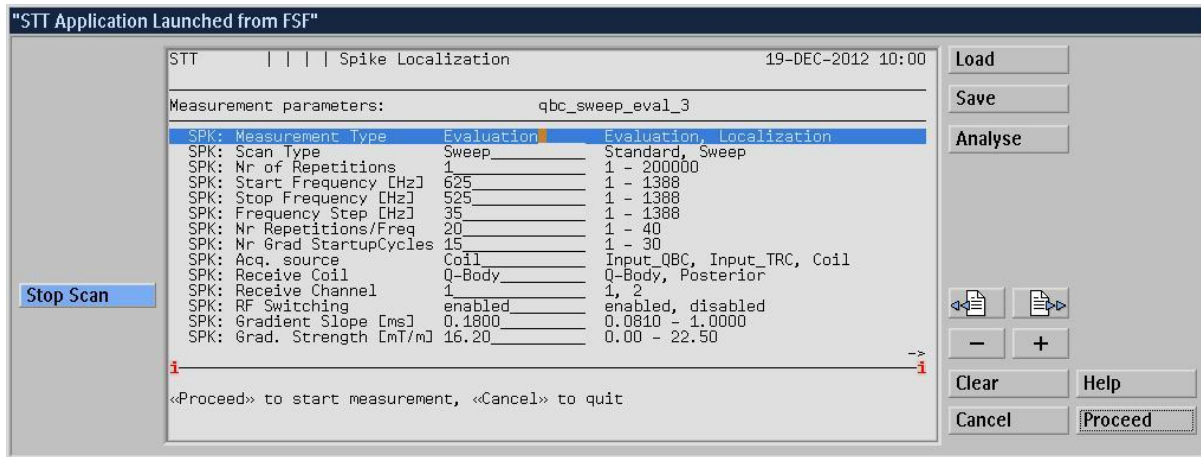
The Spike Localization tool parameter screen

Click on the <Load> button (right top) to load a particular parameter set. The following screen will come up:



Available parameter sets in Spike Localization

The MRL of the Body coil sweep showed the highest QPI values in the frequency range 625-525 Hz. Therefore, select the parameter set **ttspk_qbc_sweep_eval_3**, click <Proceed> to load it. The following screen will come up:



Parameterset qbc_sweep_eval_3, with default settings

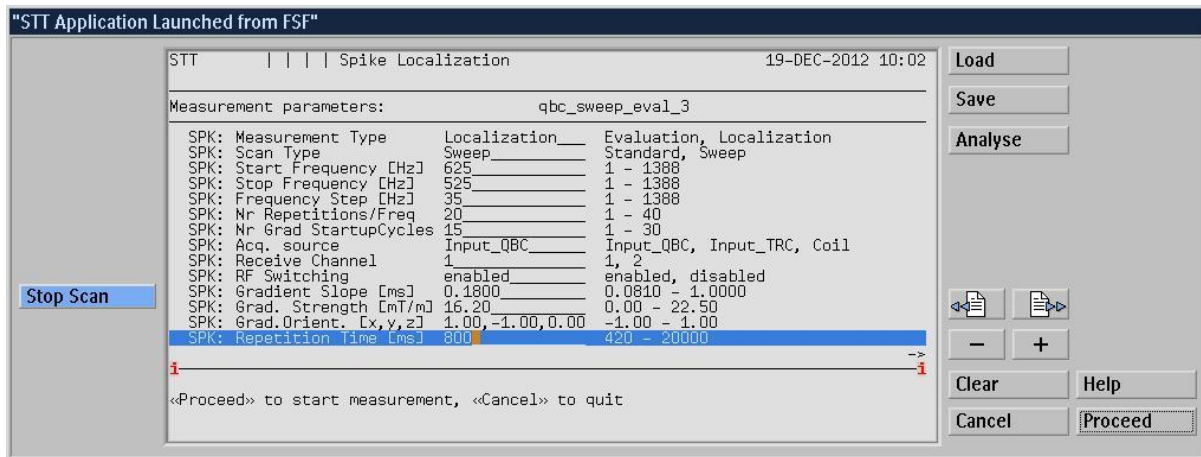
The frequency range is automatically set to 625-525 Hz and the gradient strength is set to the correct value for this frequency range (16.20 mT/m).

To start spike localization using the C1 coil make the following changes:

set the parameter Measurement Type to **Localization**

set the parameter Acq. Source to **Input QBC**

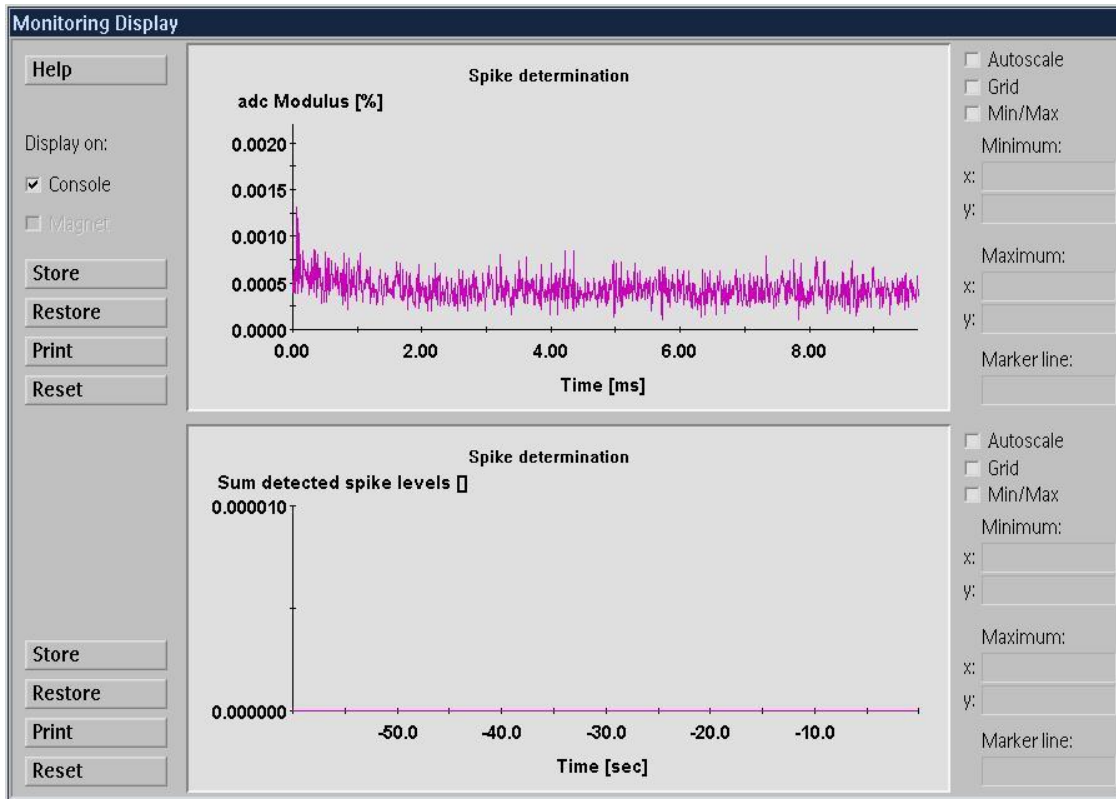
Reduce the frequency range (start/stop freq.) depending on the value found in the MRL.



Parameterset qbc_sweep_eval_3, with modified settings

After pressing <PROCEED> the measurement will start.

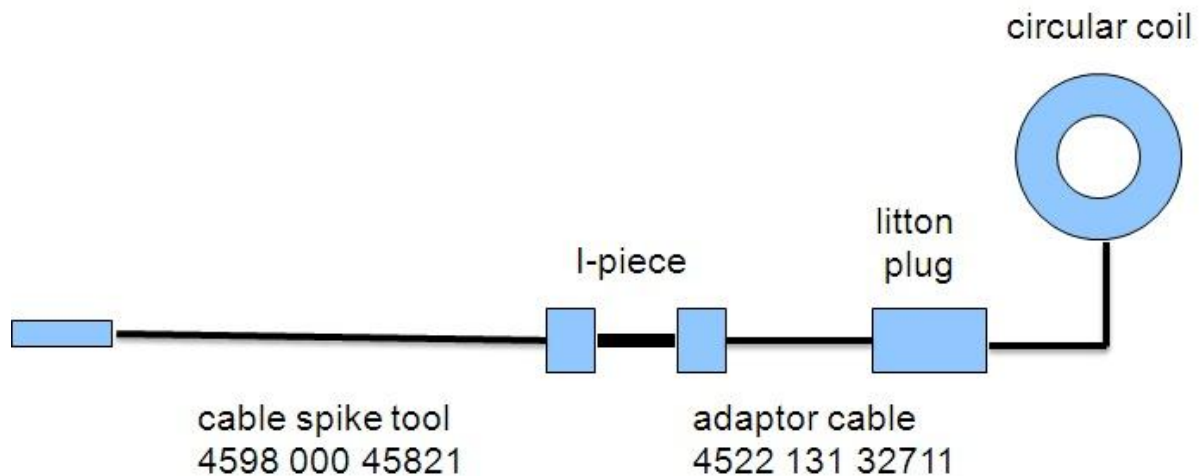
During the measurement a monitoring display shows real-time the spike amplitude (top) and the sum of the detected spikes (bottom)



The monitoring display screen during Spike localization

NOTE

In this particular example no spikes were detected with the C1 coil. The reason for this is the fact that the C1 coil is rather un-sensitive. With the setup below any circular coil from an Achieva 3T system can be used:



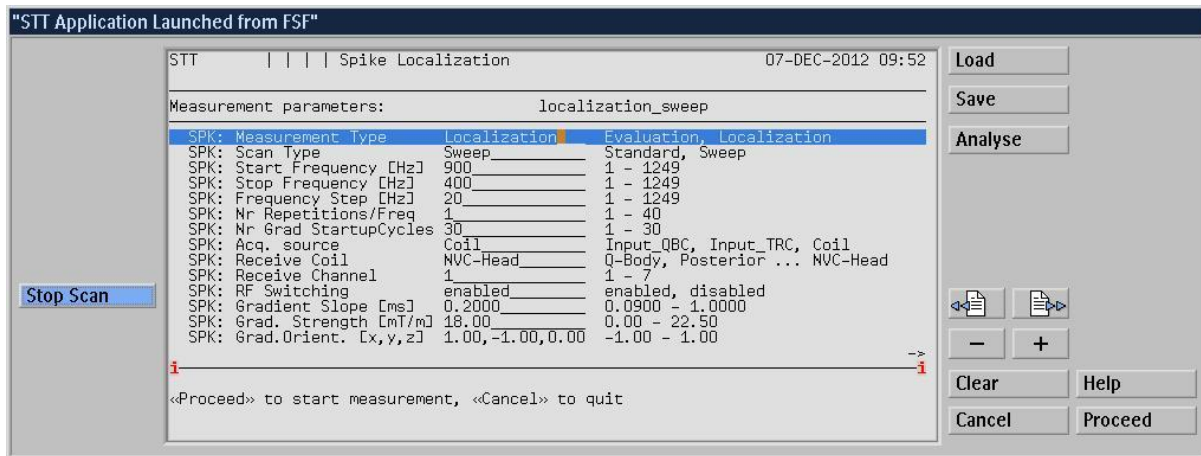
The adaptor cable 4522 131 32711 is part of the accessory set of the Achieva 3T, the spike tool cable 4598 000 45821 is delivered with the Ingenia.

Spike localization with the NVC-head coil

As already mentioned the C1 coil is not very sensitive, so low level spikes will not be detected. It might be useful to use a more sensitive coil, e.g., the NVC head coil. This coil has a very short cable and cannot be moved around the system, but by moving the table top in and out the bore it can be concluded if the spike source is at the front, center, or rear side of the magnet.

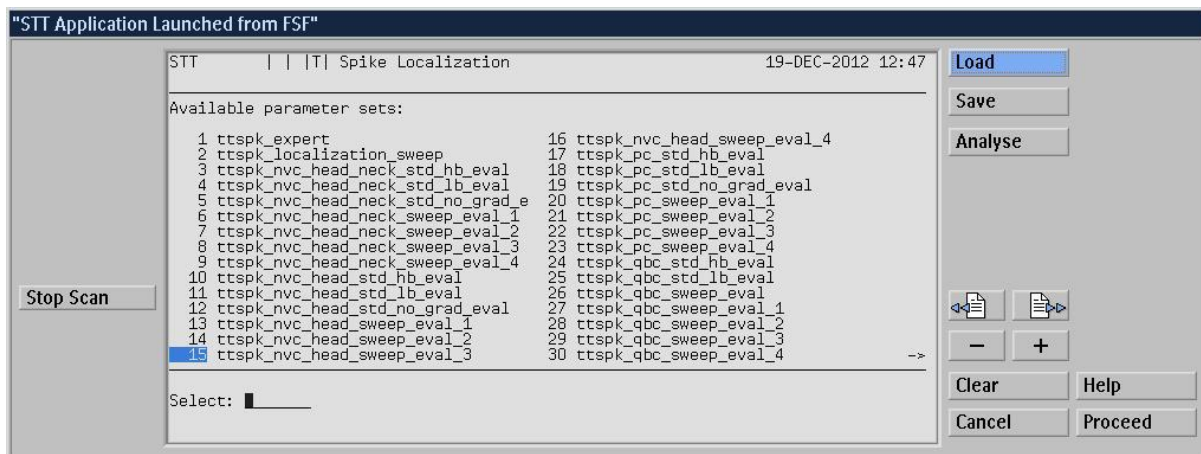
Procedure:

- Start the spike localization tool, and connect the NVC-head coil to the system.



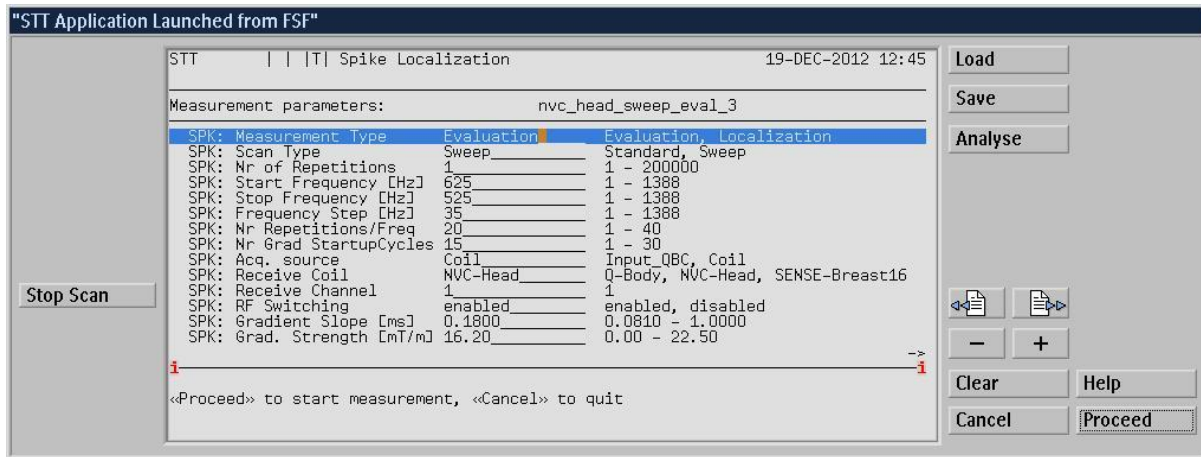
The Spike Localization tool parameter screen

Click on the <Load> button (right top) to load a particular parameter set. The following screen will come up:



Available parameter sets in Spike Localization

The MRL of the Body coil sweep showed the highest QPI values in the frequency range 625-525 Hz. Therefore, select the parameter set **ttspk_nvc_head_sweep_eval_3**, click <Proceed> to load it. The following screen will come up:



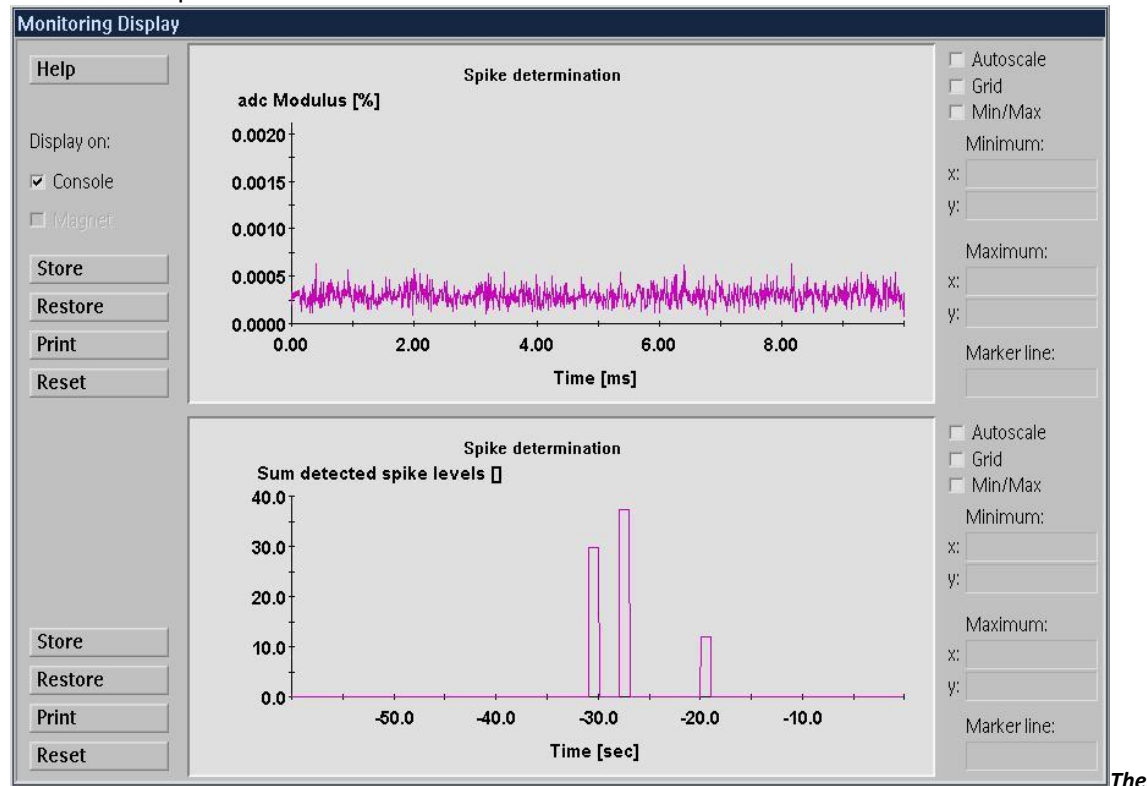
Parameterset nvc_sweep_eval_3, with default settings

The frequency range is set to 625-525 Hz and the gradient strength is set to the correct value for this frequency range (16.20 mT/m).

To start spike localization set the parameter Measurement Type to **Localization**

After pressing <PROCEED> the measurement will start.

During the measurement a monitoring display shows real-time the spike amplitude (top) and the sum of the detected spikes



monitoring display screen during Spike localization

By moving the NVC head coil to the front side of the magnet, the centre, and the rear side of the magnet the source of the spikes can roughly be determined.

In this example relatively high levels were measured at the magnet rear side and nothing at the centre and front side. Please note that this is only a 'coarse' check: additional localization with a sniffer coil will be required to determine the exact spike source.

Spike localization with the flex-M coils

All available coils on the Ingenia system can be used for spike searching, but not all coils are convenient to use.

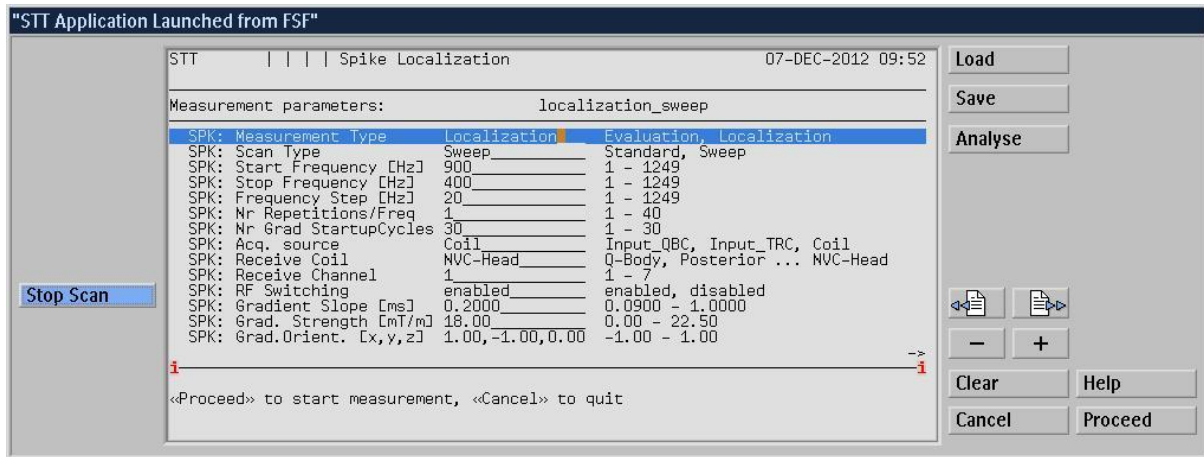
The flex-M coils are very useful because they have relatively long cables, allowing some search functionality. So if these coils are available it is recommended to use them for searching



The flex-M coils connected to the dStream interface. During 'real life' spike searching the covers are removed

Procedure:

- Start the spike localization tool, and connect the flex-M coils to the dStream interface.

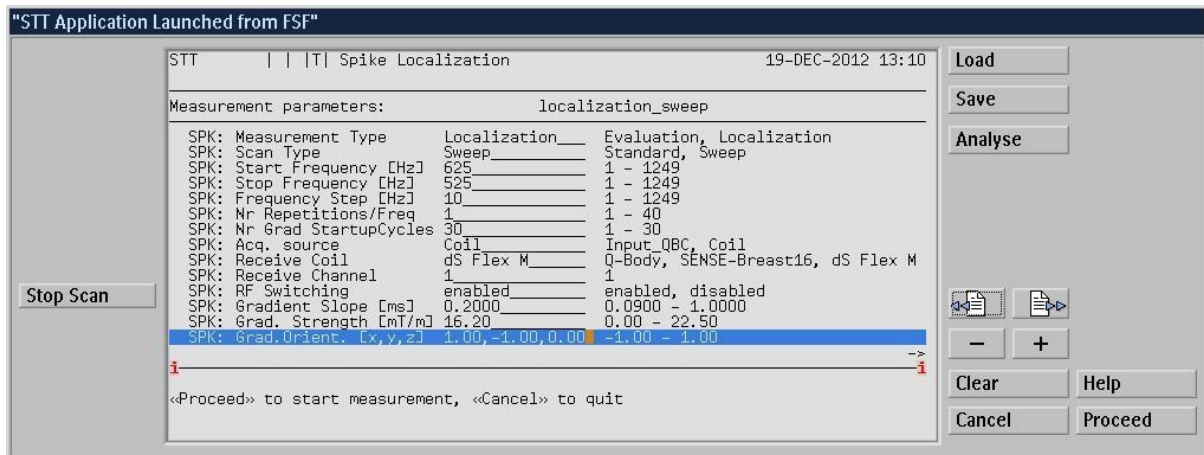


The Spike Localization tool parameter screen, default

For the flex-M coils no pre-defined parameter sets are available, so the Localization settings have to be modified. The start and stop frequencies have to be set to the frequency range where the highest spike levels were detected in the Body coil or NVC-head coil sweep, in this example 625 – 525 Hz. In this frequency interval a maximum gradient strength of 16.20 mT/m is defined.

Changes to be made:

- Set the Start Frequency to 625 Hz
- Set the Stop Frequency to 525 Hz
- Set the Frequency Step to 10Hz
- Set the Acquisition source to Coil
- Set the Receive coil to Flex M
- Set the gradient Strength to 16.20 mT/m
- Set the Display Time to 1 minute (this setting is on the second configuration screen)



The Spike Localization tool parameter screen with changed settings

Press <Proceed> to start the measurement

Appendix A MRL of a spike (sweep) test

Test Result Details

Test Name: Spike test QBC (sweep) 1300-950Hz

Result: Warning

Flag	Parameter Name	Actual Value	Nominal Value	Spec Value
	SPK: Noise QPI	0.23		<2.0
!	SPK: Visibility QPI	4.37		<1.0
	SPK: Avg. nr Spikes	0.06		
	SPK: Maximum Spike Level	80.92		
	SPK: Sweep Frequencies 1	1300.00		
	SPK: Sweep Frequencies 2	1265.00		
	SPK: Sweep Frequencies 3	1230.00		
	SPK: Sweep Frequencies 4	1195.00		
	SPK: Sweep Frequencies 5	1160.00		
	SPK: Sweep Frequencies 6	1125.00		
	SPK: Sweep Frequencies 7	1090.00		
	SPK: Sweep Frequencies 8	1055.00		
	SPK: Sweep Frequencies 9	1020.00		
	SPK: Sweep Frequencies 10	985.00		
	SPK: Sweep Frequencies 11	950.00		
	SPK: Max Spike Level/ Freq 1	0.00		
	SPK: Max Spike Level/ Freq 2	6.72		
	SPK: Max Spike Level/ Freq 3	0.00		
	SPK: Max Spike Level/ Freq 4	80.92		
	SPK: Max Spike Level/ Freq 5	0.00		
	SPK: Max Spike Level/ Freq 6	0.00		
	SPK: Max Spike Level/ Freq 7	8.98		
	SPK: Max Spike Level/ Freq 8	7.10		
	SPK: Max Spike Level/ Freq 9	0.00		
	SPK: Max Spike Level/ Freq 10	6.31		
	SPK: Max Spike Level/ Freq 11	6.61		
	SPK: Freq with most Spikes	1195		
	SPK: Freq.withLargestSpike	1195		

Found spikes can cause wavy pattern in image

Test Name: Spike test QBC (sweep) 949-626Hz

Result: Warning

Flag	Parameter Name	Actual Value	Nominal Value	Spec Value
!	SPK: Noise QPI	2.08		<2.0
!	SPK: Visibility QPI	22.59		<1.0
	SPK: Avg. nr Spikes	0.33		
	SPK: Maximum Spike Level	125.90		
	SPK: Sweep Frequencies 1	949.00		
	SPK: Sweep Frequencies 2	914.00		
	SPK: Sweep Frequencies 3	879.00		
	SPK: Sweep Frequencies 4	844.00		
	SPK: Sweep Frequencies 5	809.00		
	SPK: Sweep Frequencies 6	774.00		
	SPK: Sweep Frequencies 7	739.00		
	SPK: Sweep Frequencies 8	704.00		
	SPK: Sweep Frequencies 9	669.00		
	SPK: Sweep Frequencies 10	634.00		
	SPK: Max Spike Level/ Freq 1	125.90		
	SPK: Max Spike Level/ Freq 2	0.00		
	SPK: Max Spike Level/ Freq 3	0.00		
	SPK: Max Spike Level/ Freq 4	66.41		
	SPK: Max Spike Level/ Freq 5	0.00		
	SPK: Max Spike Level/ Freq 6	0.00		
	SPK: Max Spike Level/ Freq 7	0.00		
	SPK: Max Spike Level/ Freq 8	6.30		
	SPK: Max Spike Level/ Freq 9	0.00		
	SPK: Max Spike Level/ Freq 10	7.01		
	SPK: Freq with most Spikes	949		
	SPK: Freq.withLargestSpike	949		

Found spikes can cause increase of noise level of image
 Found spikes can cause wavy pattern in image

Test Name: Spike test QBC (sweep) 625-525Hz

Result: Warning

Flag	Parameter Name	Actual Value	Nominal Value	Spec Value
!	SPK: Noise QPI	2.93		<2.0
!	SPK: Visibility QPI	25.42		<1.0
	SPK: Avg. nr Spikes	0.12		
	SPK: Maximum Spike Level	179.24		
	SPK: Sweep Frequencies 1	625.00		
	SPK: Sweep Frequencies 2	590.00		
	SPK: Sweep Frequencies 3	555.00		
	SPK: Max Spike Level/ Freq 1	6.04		
	SPK: Max Spike Level/ Freq 2	179.24		
	SPK: Max Spike Level/ Freq 3	6.25		
	SPK: Freq with most Spikes	590		
	SPK: Freq.withLargestSpike	590		

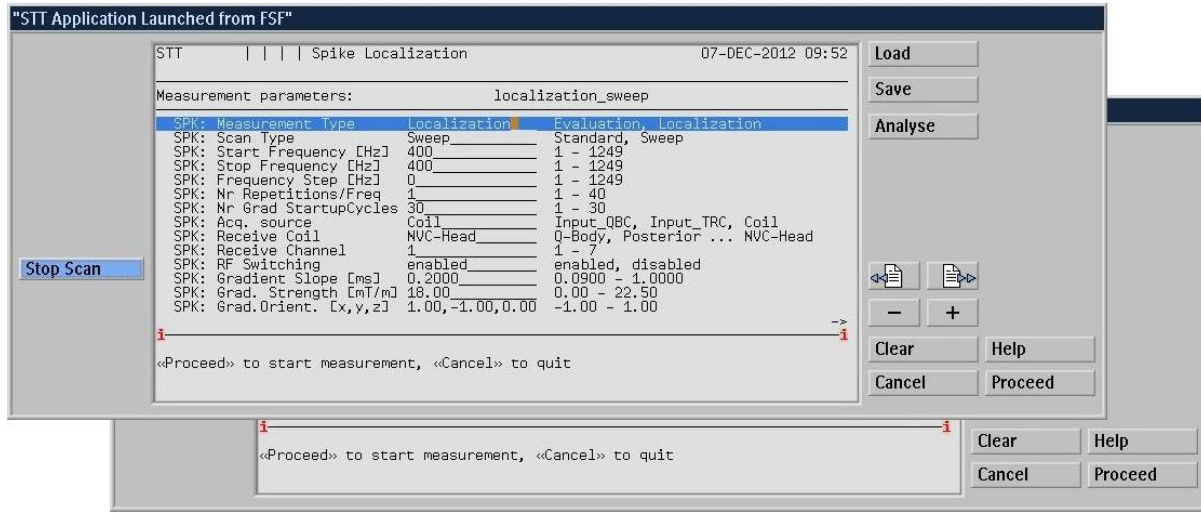
Found spikes can cause increase of noise level of image
Found spikes can cause wavy pattern in image

Test Name: Spike test QBC (sweep) 524-300Hz

Result: Passed

Flag	Parameter Name	Actual Value	Nominal Value	Spec Value
	SPK: Noise QPI	0.00		<2.0
	SPK: Visibility QPI	0.00		<1.0
	SPK: Avg. nr Spikes	0.01		
	SPK: Maximum Spike Level	6.63		
	SPK: Sweep Frequencies 1	524.00		
	SPK: Sweep Frequencies 2	489.00		
	SPK: Sweep Frequencies 3	454.00		
	SPK: Sweep Frequencies 4	419.00		
	SPK: Sweep Frequencies 5	384.00		
	SPK: Sweep Frequencies 6	349.00		
	SPK: Sweep Frequencies 7	314.00		
	SPK: Max Spike Level/ Freq 1	0.00		
	SPK: Max Spike Level/ Freq 2	0.00		
	SPK: Max Spike Level/ Freq 3	0.00		
	SPK: Max Spike Level/ Freq 4	0.00		
	SPK: Max Spike Level/ Freq 5	0.00		
	SPK: Max Spike Level/ Freq 6	0.00		
	SPK: Max Spike Level/ Freq 7	6.63		
	SPK: Freq with most Spikes	314		
	SPK: Freq.withLargestSpike	314		

Appendix B– parameters of the spike localization tool



There are 2 configuration screens where a number of settings can be done.

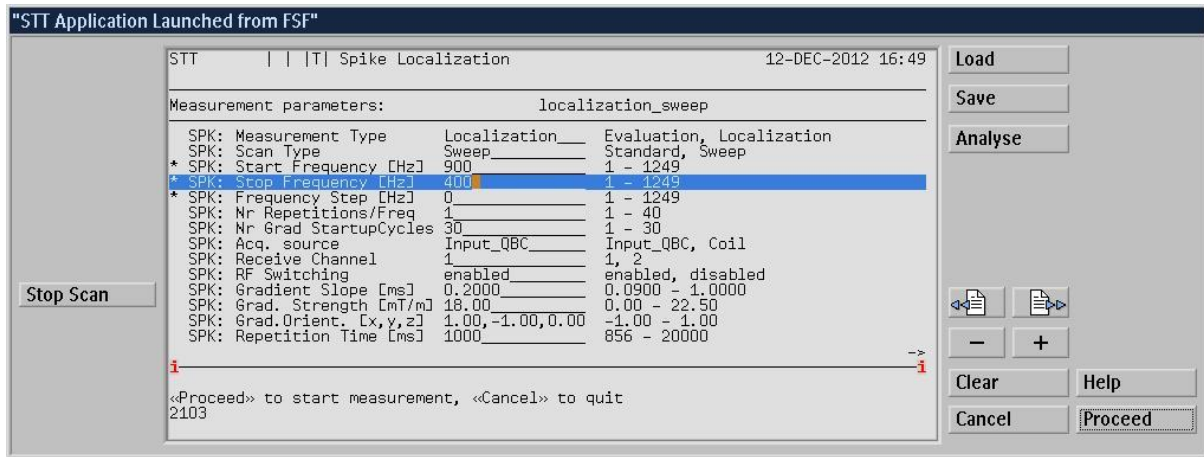
- SPK: Measurement type determines the measurement type. **Evaluation** can be used to quantify the spike behavior of the system. It is not allowed to open the RF door and an MRL is created after the measurement. **Localization** can be used to localize a spike source. It is allowed to open the RF door to enter the RF room. During the measurement two graphs are displayed: the actual system response and the number of spikes that were counted during the past minutes. Front-end interlocks are disabled, allowing for example the removal of hybrid box or QBC.
- SPK: Scan Type determines the gradient sequence. Set this to **Sweep (default)**; the gradient frequency will decay from the start frequency to the stop frequency as programmed below
- SPK: Start Frequency [Hz] Start frequency for gradient sweep
- SPK: Stop Frequency [Hz] Stop frequency for gradient sweep
- SPK: Frequency Step [Hz] Frequency step
- SPK: Nr Repetitions/Freq Number of times that a gradient frequency is repeated.
- SPK: Nr Grad StartupCycles Number of gradient pulses which is generated before the actual measurement is started.
- SPK: Acq. Source Select a signal source here:
- Input QBC: a sniffer coil (C1) can be used. Connect this coil to X10 of the TFINT board (= QBC receive channel 1)

- **coil**: a system coil that is connected to the system can be used.

SPK: Receive Coil	If Acq. Source is set to Coil, the receive coil can be selected here. NOTE: only coils that are connected to the system (optical connectors or dStream interface) can be selected
SPK: Receive Channel	If Acq. Source is set to Q-Body, the QBC receive channel can be selected here.
SPK: RF switching	When enabled the hybrid box (QIB) will be switched from receive to transmit between the runs. Connected coil and the QBC will be switched from tune to detune. (No RF is sent)
SPK: Gradient Slope [ms]	The slope of the gradient waveform, leave on default
SPK: Grad.Strength [mT/m]	The gradient strength which is used during the measurement.
SPK: Grad. Orient.[x,y,z]	The gradient orientation. The default setting is [1,-1,0] meaning: X and Y gradient in opposite directions and no Z gradient. By making changes in orientation the spike behavior sometimes changes.
SPK: Repetition Time [ms]	The repetition times between the gradient pulses.
SPK: Acq. Duration [ms]	The interval during which acquisition is performed after the gradient pulse has ended.
SPK: Acq. Begin Time[ms]	The starting point of the data acquisition relative to the start of the first acquisition gradient pulse.
SPK: Display Time [min]	The minimum period over which the evolution is displayed of the sum of the spike levels. When equal to 0 the shortest display time will be chosen.
SPK: Nr Avg/Display Update	This parameter defines after how many repetition times the statistics view is updated. Default 1
SPK: Vis.Spike DetectLevel	The detection level (relative to the background noise level) of spikes to be part of the visibility QPI. The default value is 70, this means that only spikes that are more than 70 times the level of the background noise are counted for the visibility QPI calculation

If one or more parameters are changed, a conflict might be introduced. If for example the Start Frequency is changed to 900, the stop frequency is set to 400 and the frequency step is set to 0 there is a conflict because this would result in an endless loop. The conflicting parameters are indicated by an asterisk *.

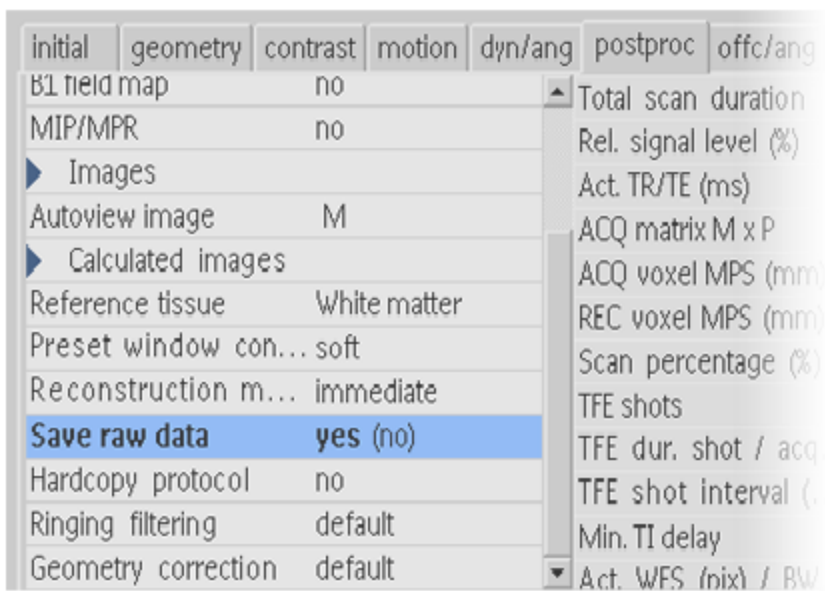
See screengrab:

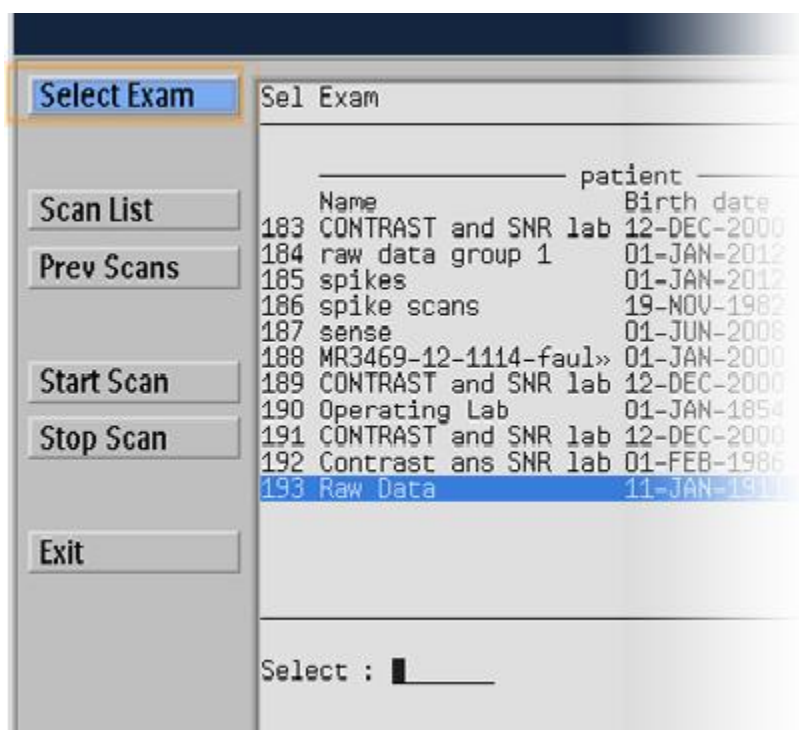
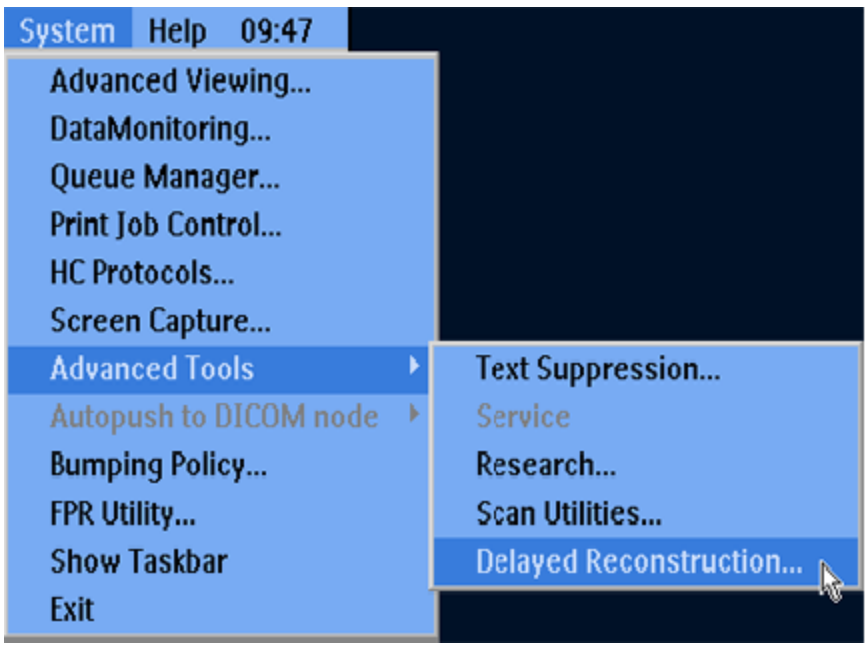


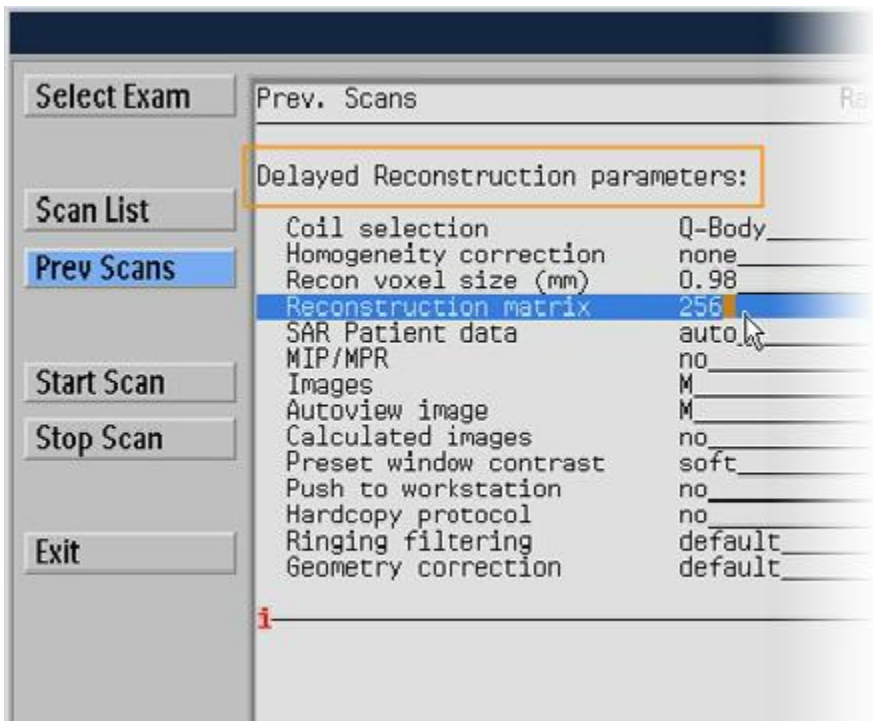
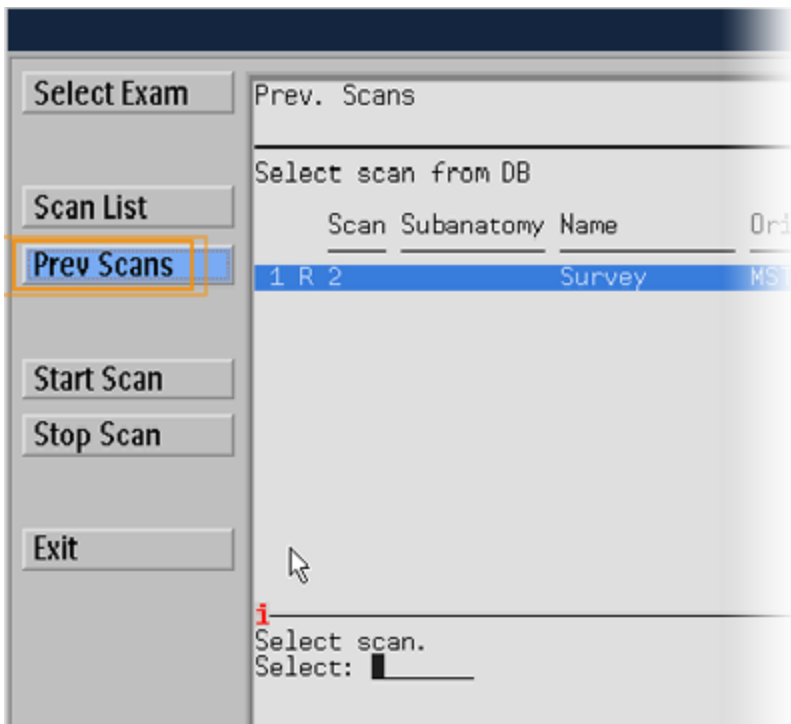
In this example setting a relevant frequency step

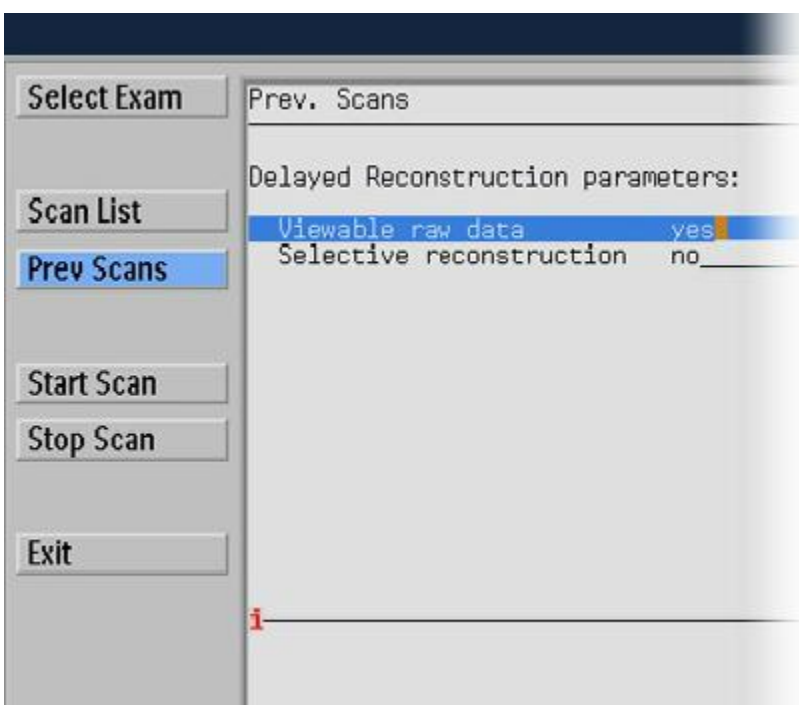
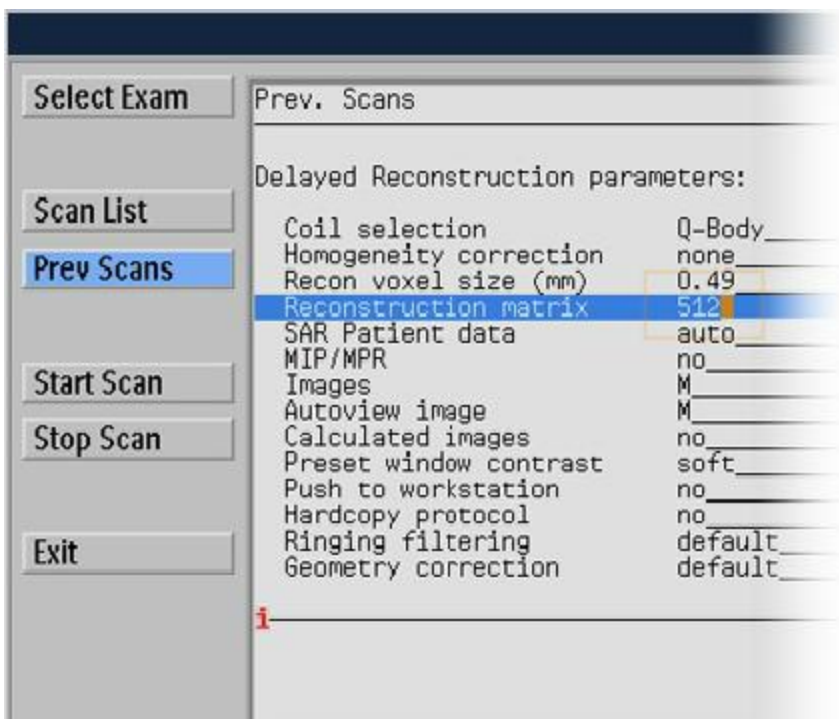
Make Raw Data visible

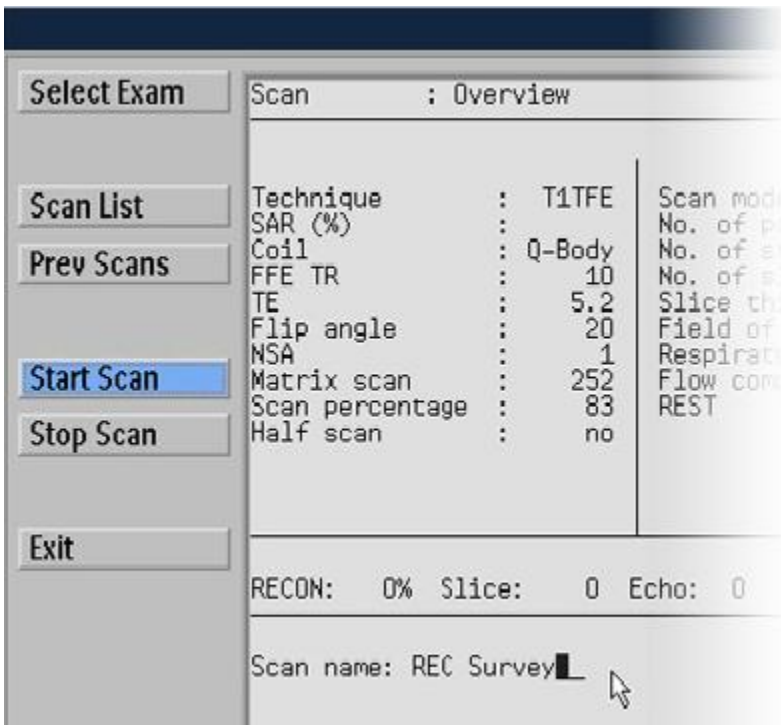
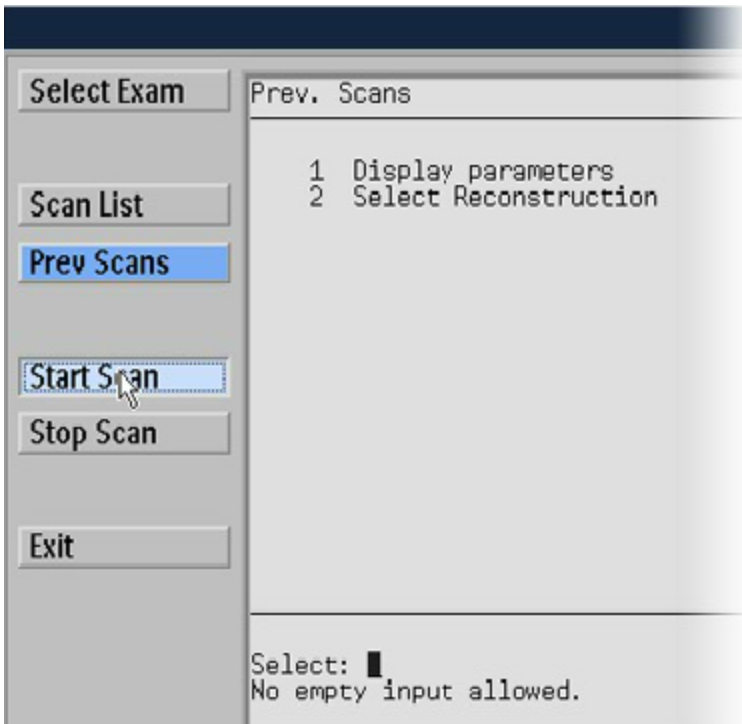
Release 1,2 and 3.

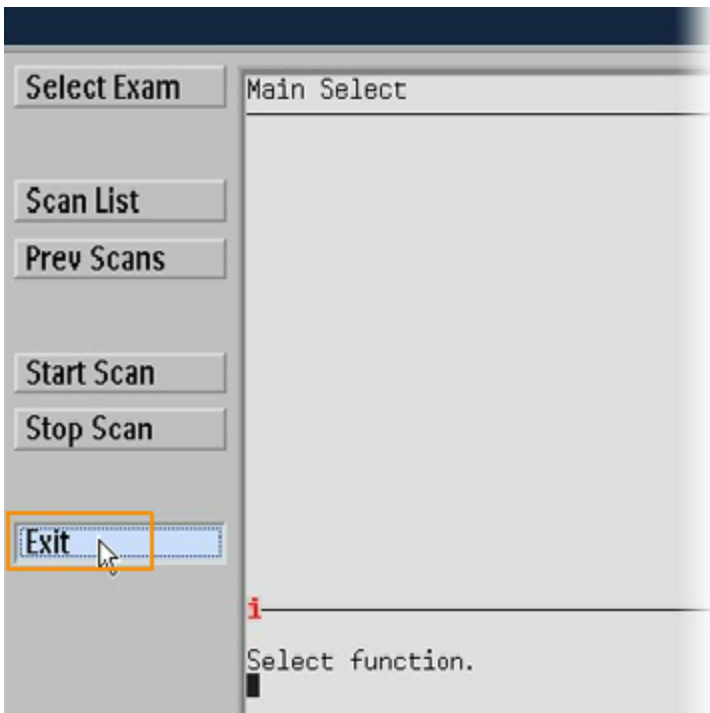












Make Raw Data visible

Release 4 or higher.

Initial		geometry	contrast	motion	dyn/ang	postproc	offc/ang	colls	conflicts
FOV	FH (mm)	450	(250)	Total scan duration		00:18.9			
	AP (mm)	450	(250)	Rel. signal level (%)		100			
stack	RL (mm)	10	(50)	Act. TR/TE (ms)		10 / 5.1			
Voxel size	FH (mm)	1	(0.98)	ACQ matrix M x P		452 x 420			
	AP (mm)	1	(1.95)	ACQ voxel MPS (mm)		1.00 / 1.07 / 10.0			
Slice thickness (mm)		10		REC voxel MPS (mm)		0.94 / 0.94 / 10.0			
Stacks		3		Scan percentage (%)		92.9			
fold-over direction		AP		TFE shots		10			
TE		shortest		TFE dur. shot / acq (ms)		484.7 / 430.2			
TR		shortest	(user de...	TFE shot interval (ms)		484.7			
NSA		1		Min. TI delay		259.2			
Preparation phases		auto		Act. WFS (pix) / BW (Hz)		1.139 / 190.7			
Images				Min. WFS (pix) / Max. B...		0.512 / 423.9			
				SAR / local torso		< 15%			
				Whole body / level		< 0.4 W/kg / normal			
				Scan SED		< 7.0 J/kg			
				B1 rms		1.62 uT			
				PNS / level		19% / normal			
				Sound Pressure Level (...)		-3.9			

Initial		geometry	contrast	motion	dyn/ang	postproc	offc/ang	coils	conflicts
Preparation phases				auto		Total scan duration			00:18.9
Interactive FO				no		Rel. signal level (%)			100
MIP/MPR				no		Act. TR/TE (ms)			10 / 5.1
▶ Images						ACQ matrix M x P			452 x 420
Autoview image				M		ACQ voxel MPS (mm)			1.00 / 1.07 / 10.0
▶ Calculated images						REC voxel MPS (mm)			0.94 / 0.94 / 10.0
Reference tissue				White matter		Scan percentage (%)			92.9
Recon compression				No		TFE shots			10
Preset window contrast				soft		TFE dur. shot / acq (ms)			484.7 / 430.2
Reconstruction mode				immediate		TFE shot interval (ms)			484.7
Save raw data				no		Min. TI delay			259.2
Hardcopy protocol				no		Act. WFS (pix) / BW (Hz)			1.139 / 190.7
Ringing filtering						Min. WFS (pix) / Max. B...			0.512 / 423.9
Geometry correction				default		SAR / local torso			< 15 %
						Whole body / level			< 0.4 W/kg / normal
						Scan SED			< 7.0 J/kg
						B1 rms			1.62 uT
						PNS / level			19 % / normal
						Sound Pressure Level (...)			-3.9

Initial		geometry	contrast	motion	dyn/ang	postproc	offc/ang	coils	conflicts
Preparation phases				auto		Total scan duration			00:18.9
Interactive FO				no		Rel. signal level (%)			100
MIP/MPR				no		Act. TR/TE (ms)			10 / 5.1
▶ Images						ACQ matrix M x P			452 x 420
Autoview image				M		ACQ voxel MPS (mm)			1.00 / 1.07 / 10.0
▶ Calculated images						REC voxel MPS (mm)			0.94 / 0.94 / 10.0
Reference tissue				White matter		Scan percentage (%)			92.9
Recon compression				No		TFE shots			10
Preset window contrast				soft		TFE dur. shot / acq (ms)			484.7 / 430.2
Reconstruction mode				immediate		TFE shot interval (ms)			484.7
Save raw data				yes (no)		Min. TI delay			259.2
Hardcopy protocol				no		Act. WFS (pix) / BW (Hz)			1.139 / 190.7
Ringing filtering				default		Min. WFS (pix) / Max. B...			0.512 / 423.9
Geometry correction				default		SAR / local torso			< 15 %
						Whole body / level			< 0.4 W/kg / normal
						Scan SED			< 7.0 J/kg
						B1 rms			1.62 uT
						PNS / level			19 % / normal
						Sound Pressure Level (...)			-3.9

